AD-A173 337 THE POINT POSITION DATA (PPDB): THE FUTURE(U) DEFENSE MAPPING AGENCY WASHINGTON DC B D WAXMAN ET AL. 08 OCT 86 1/1

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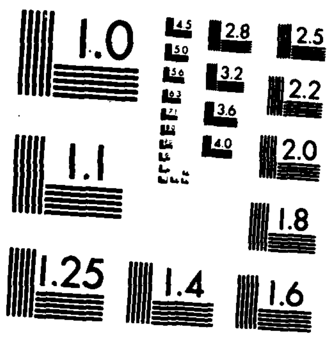

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Point Positioning Data Bases (PPDBs) are sets of stereo images for which exploitation parameters have been predetermined and recorded on machine readable media. The imagery provides complete systematic coverage of a project area. A typical PPDB product currently contains image film positives, image paper prints, machine readable media with exploitation parameters, an atlas of image coverage and user instructions. PPDBs require an exploitation workstation. The workstation, or Analytical Point Positioning System (APPS), includes a stereo comparator, an IO device for reading parameters and a computer.

Upgrade of the photo-based PPDB to a digital PPDB is inevitable. It would be a mistake to assume that a digital PPDB is different from the conventional PPDB only in the sense that imagery is encoded in digital form and stored on magnetic/optical media. Digital PPDB has a much broader functionality than conventional PPDB. Once a digital PPDB is available to
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THE POINT POSITION DATA BASE (PPDB), THE FUTURE

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BACKGROUND

Point Positioning Data Bases (PPDBs) are sets of stereo images for which exploitation parameters have been predetermined and recorded on machine readable media. The imagery provides complete systematic coverage of a project area. A typical PPDB product currently contains image film positives, image paper prints, machine readable media with exploitation parameters, an atlas of image coverage and user instructions.

PPDBs require an exploitation workstation. The workstation, or Analytical Point Positioning System (APPS), includes a stereo comparator, an IO device for reading parameters and a computer. The computer controls the comparator, accepts measurements from the comparator and performs point positioning calculations using the exploitation parameters. Input/output devices for system control, reporting of system status and reporting point location data are also, of course, included in the workstation.

PPDB exploitation generally begins with an intelligence photograph of some feature for which precise ground coordinates are desired. The approximate geographic location of the feature must also be known. The approximate location information and the PPDB Atlas are used to identify the stereo image pair of interest. The pair is retrieved and placed on the stereo comparator carriages. Initialization measurements are performed. The ground point coincident with the feature of interest is located in the PPDB by matching image features common to both the intelligence image and the PPDB imagery. Finally, stereo mensuration is performed and resultant measurements transferred to the computer for derivation of ground coordinates. The mensuration procedure requires reseau intersections in the neighborhood of the derived point be measured to determine film distortions in the PPDB imagery.

DIGITAL PPDB

Upgrade of the photo-based PPDB to a digital PPDB is inevitable. It would be a mistake to assume that a digital

PPDB is different from the conventional PPDB only in the sense that imagery is encoded in digital form and stored on magnetic/optical media. Digital PPDB has a much broader functionality than conventional PPDB.

Once a digital PPDB is available to field users, its usefulness will extend far beyond point positioning. A wealth of image analysis and feature extraction technology that previously could be used only at Defense Mapping Agency (DMA) facilities can eventually be exploited at user sites. Thus, although paper maps and charts will always be valuable reference sources, users may rely increasingly on up-to-date surveillance imagery geometrically registered to precise earth coordinates (WGS 84), then displayed and manipulated electronically, to fulfill wartime needs for current geographic information. Since such a trend is likely, DMA has re-evaluated the desirability of supporting electronic display and manipulation of its imagery as a logical extension of its traditional role of providing classic hardcopy products.

DEPLOYABLE DIGITAL DATA BASE (D^3B)

The concept of a Deployable Digital Data Base (D^3B) is not particularly revolutionary. But the degree to which DMA is prepared to place its basic cartographic data and extraction in the field represents a dramatic change. DMA historically has provided relatively unprocessed cartographic source materials (i.e., photomaps and pictomaps) to field users, particularly when fully processed cartographic products were unavailable or difficult to maintain in current condition. The Point Positioning Data Base (PPDB), which provides metricized imagery for precise on-site point positioning, can be regarded as the D^3B's forerunner. The PPDB and the D^3B differ in three ways: the D^3B's metricized imagery is digital, the D^3B incorporates DMA's Standard terrain elevation and feature data and the D^3B includes information extraction and display software that the Armed Services may elect to use.

The D^3B is a collection of data--source material (e.g., digital PPDB) and standard MC&G products (i.e., DTED and DFAD)--and data exploitation software for terrain and feature data augmentation, perspective scene and thematic map generation and data base management to organize and superposition multiple data layers and types. The D^3B will permit data from other sensors and intelligence sources to be added and, once added, become a part of the D^3B and usable in extraction and display operations.

DEVELOPMENT STRATEGY

Because a successfully implemented digital PPDB is at the heart of the D^{3}B, DMA will begin by developing a digital PPDB. Digital PPDB is inherently more powerful than an analog PPDB and can be electronically transmitted to users in near real time (if required), which will help in targeting relocatable objects, and, with the D^{3}B upgrade, the imagery itself can be exploited in a number of ways. A prototype field-deployable exploitation workstation will be developed as a substitute for the APPS, the current analog exploitation device.

Upgrade of the digital PPDB to the D^{3}B involves adding software for a variety of data entry, data capture, data manipulation and image display capabilities .

The prototype field-deployable D^{3}B workstation will have the following components and capabilities:

a. Hardware. Workstation hardware will be comprised of a high-speed image display device (a Pixar, or similar inexpensive parallel processor), host processor, and storage media to include an optical disk system with each platter capable of handling from 2-8 gigabytes.

b. Data Base Management System (DBMS). The DBMS will provide access to user requested imagery and data in a specified area of interest and as such will replace, at a minimum, the functionality of the current PPDB Atlas. Imagery and data will be accessed via coordinates (latitude/longitude or UTM) or by placenames (which are referenced by the system to coordinates). The DBMS will also perform registration and superpositioning of all D^{3}B data; imagery, map, elevation matrix, and features, for display and analytical purposes. Registration capabilities will include image-to-image, image-to-map, image-to-DTED, and image-to-feature data. Imagery to be registered will include digital PPDBs, SAR or multispectra, digitized photography, and any other digital image for which a sensor model is available and acquisition parameters can be recovered.

c. Interactive Reconnaissance Data Entry. The D^{3}B will permit users to add data gathered *in situ*. Such data may be reconnaissance imagery, or measurements and samples taken at point. Input imagery will be incorporated by the DBMS into the system file structures and will be usable in the same way as DMA-supplied imagery. Data gathered from

field survey and sampling could be vegetation attributes (stem diameter and spacing, or undergrowth and density and height), description of surface materials (ground moisture, depth of surface materials, or depth to bedrock), drainage characteristics (stream bottom material, bank height, slope, or vegetation density, water velocity or depth, or ice conditions), or updated transportation data (destruction or damage, altered surfaces, clearances, or obstacles). Thus, such data might apply to a delineated area or to a single point. To facilitate such additions, the D^3B will display map or image graphics with which the user can interact during data entry, and will accept the input data and incorporate it into the system file structure.

d. Interactive 2-D Feature Extraction. Using metricized imagery (stereo or mono) or digitized maps with DFAD or other feature data optionally superimposed, it will be possible to delineate features, assign standard codes for feature types and attributes, and format the data. This capability relies on photo, image, or map interpretation (but not reconnaissance, as did the previous enhancement capability) to derive specific feature type and attribute information.

e. Interactive 3-D Feature Extraction. Using DMA or user-supplied stereo or mono metricized imagery, it will be possible to mensurate or approximate individual feature shapes in x, y, and z. Approximate feature shapes are used to generate scenes rapidly when realism (but not accuracy) is required.

f. Semi-automated Terrain Elevation Extraction. For users requiring higher resolution elevation matrices than DTED provided by DMA, validated software will be provided to measure elevations at finer spacings using stereo imagery and available DTED as input. Output will be a DTED-formatted elevation grid at the specified spacing.

g. Point Positioning. Software will be included that can display a latitude/longitude or UTM grid over metricized imagery in a format equivalent to current PPDB conventions. Point positioning software will also be capable of displaying coordinates for image features indicated by an operator.

h. 2-D Displays. Software will permit 2-d displays of registered images and feature analysis data. Displays will be designed for visual analysis of the superimposed data and for feedback during data enhancement operations.

i. Perspective Scene generation. Perspective Scenes will be generated by superimposing image data onto DTED and three dimensional perspective representations of mensurated cultural objects. Both mensurated and canonical (lampposts, trees, etc.) features will be portrayed in 3-D by the system at a user-specified viewing point. It is anticipated that such culture-populated, perspective scenes will have important implications as functionally appropriate, inexpensive alternatives to traditional high resolution map products (1:10,000-1:50,000 scale). Figure 1 illustrates the potential economies of image rather than map based projections.

j. Man-machine Interface. A man-machine interface will support several levels of user sophistication. The first level can be selected by new, relatively unskilled operatorslto move between and operate individual software modules with on-line interactive documentation. A second level will be geared to experienced users, who can function with minimal system prompts, and will not require previous computer expertise.

THE FUTURE

DMA intends to deliberately develop the capabilities described above as part of an overall Distribution Architecture to be available in the early 1990's. Prototype digital data bases (digital PPDB and D^3B) will be demonstrated as early as 1989 as will the associated field deployable exploitation workstation. Figure 2 depicts the overall deployment strategy.

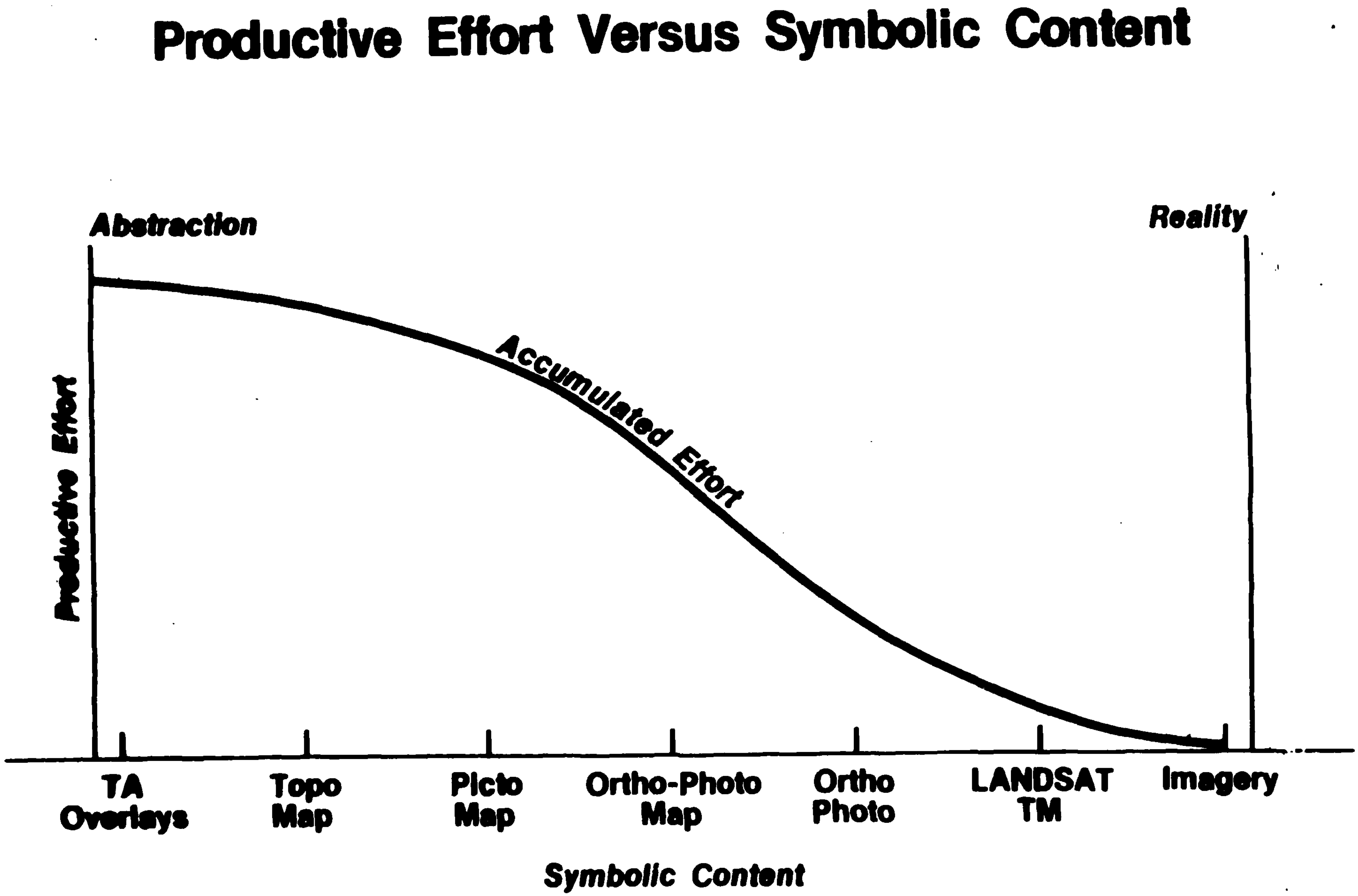
Productive Effort Versus Symbolic Content
Abstraction
Reality
Productive Effort
Accumulated Effort
TA Overlays
Topo Map
Picto Map
Ortho-Photo Map
Ortho Photo
LANDSAT TM
Imagery
Symbolic Content

Figure 1

Deployable Digital Data Base Technology

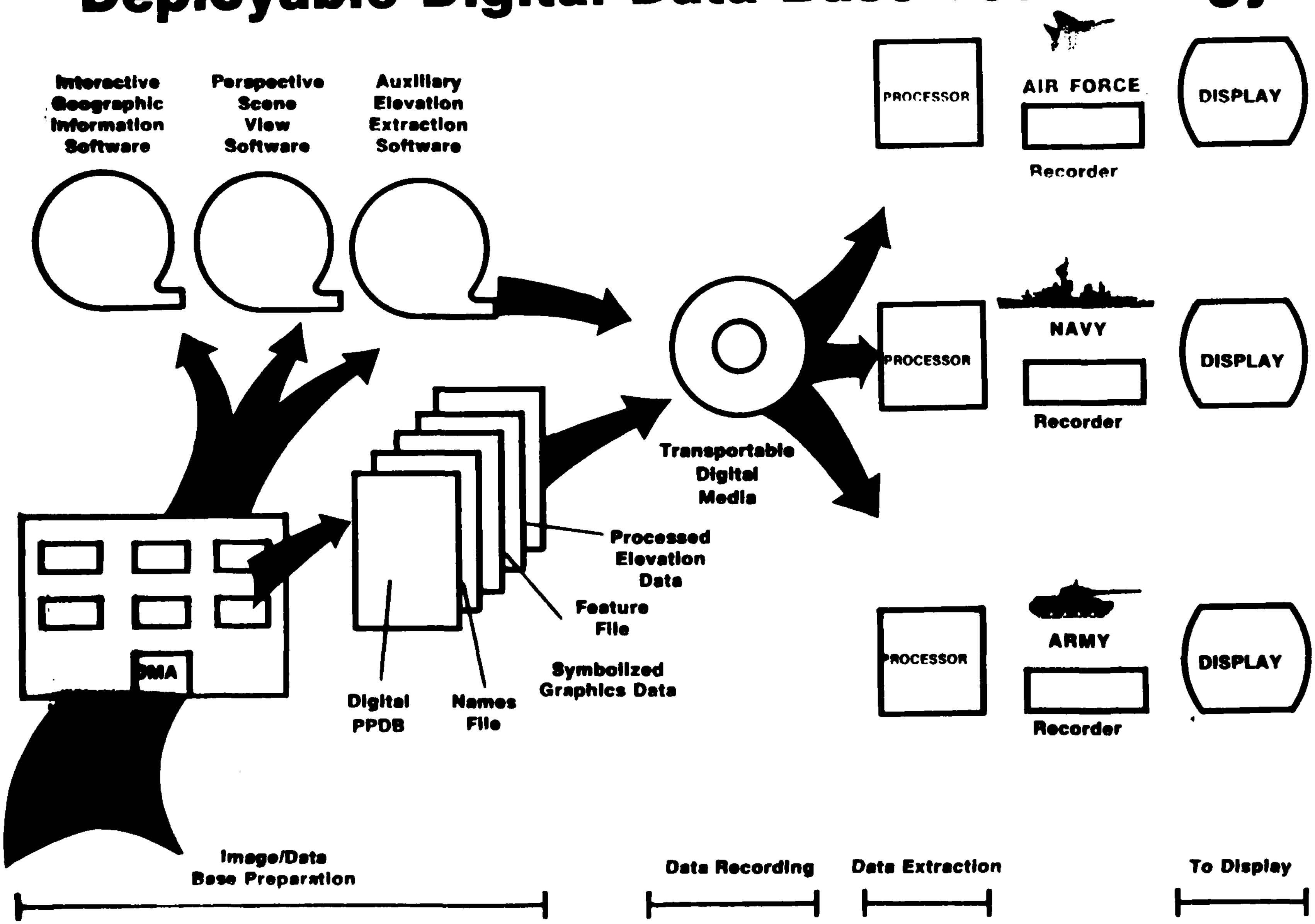

Figure 2

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